



# Installation, Operation, and Maintenance Instructions

LV High Current Transformer Bushings upto  
36kV 20000 Amp


**DISTINGUISHED PRODUCT RANGE**


			
<p>RIP bushings upto 145kV</p>	<p>OIP bushings upto 170kV with Porcelain/ Composite insulator</p>	<p>LV OIP bushings Upto 36kV 4000 A</p>	<p>LV Oil Insulated Polymer bushings upto 36 kV 3150 Amp</p>
			
<p>Oil filled/Condenser High-current bushings Upto 20000 Amps</p>	<p>Retrofit High-voltage bushings</p>	<p>Retrofit High-current bushings</p>	<p>Fibre-glass cylinder for test equipment and transformers Upto 3000 mm dia</p>
 <p>OIP wall bushings upto 170kV</p>			


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## 1. SAFETY

	<p>Work on bushings should only be performed by qualified personnel. Only materials provided by YASH must be used.</p>
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	<p><b>Caution - Do not work on systems that might be under electric tension!</b> Follow below safety rules in the given order.</p> <ol style="list-style-type: none"><li>1 Disconnect from the mains</li><li>2 Secure against reconnection</li><li>3 Verify that the system is off-line</li><li>4 Carry out earthing and short circuiting</li><li>5 Provide protection from adjacent live parts</li></ol> <p><b>Failure to comply with these rules can be mortal!</b> <i>National code of <b>safety</b> procedures and specific regional or local safety rules and regulations must be adhered.</i></p>
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	<p><b>Caution</b> Strong electromagnetic fields can occur along the bushings. People with pacemakers should not go near! Sensitive technical devices must be protected by appropriate measures.</p>
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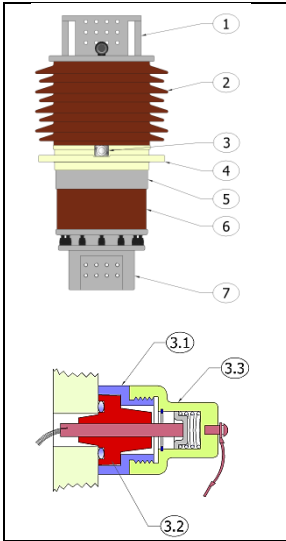
## 2. TRANSPORT

The bushing are packed and supplied in wooden box. Each bushing is sealed individually in a plastic bag with desiccant material for humidity protection. Check the packaging for any damage right after delivery.

	<p><b>Attention - transport damage</b> Obvious damage to carrier must be acknowledged to YASH as soon as possible.</p>
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	<p><b>Attention</b> - Bushings must at all times be <b>protected from moisture</b>. Keep the bushing inside plastic bag until the installation.</p>
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### 3. PRODUCT DESCRIPTION



Sl.	Part	Material
1.	Air end terminal	Refer GAD*
2.	Air end insulator	Porcelain
3.	Test tap	Epoxy
4.	Mounting flange	Aluminum
5.	Flange extension (CT space)	Aluminum
6.	Oil end insulator	Porcelain
7.	Oil end terminal	Refer GAD
3.1	Test tap housing	Aluminum
3.2	Test tap bush	Epoxy
3.3	Test tap cover	Aluminum

Figure 1: Bushing part description

\*GAD = GA Drawing

The Bushing is designed to meet the requirements of **IEC-60137** and ambient conditions thereof. The bushing is designed to operate with parts above mounting flange in air and parts below immersed in oil.

The bushing is self-contained either with OIP condenser core or insulating oil (Refer GAD). Bushings are designed for either standalone application or oil communicating type (Refer GAD).

In case of oil-insulated bushing the major insulation is transformer oil.

In case of condenser bushings, OIP condenser is the major insulation, built by winding insulating Kraft paper on a current-carrying conductor with aluminum grading foils inserted at pre-calculated locations in the paper layers, to achieve uniform voltage and electrical field distribution.

The standard OIP Bushings have TEST TAP for measurement of Capacitance and (dielectric dissipation factor) Tangent Delta. A cable is soldered on to

the last layer of conducting foil of condenser core & is crimped to the test tap stem to form TEST TAP. The test tap stem is embedded in an epoxy molded bush to insulate it all around from mounting flange. The test tap stem/stud is connected to mounting flange by means of a spring-loaded test tap cover. The mounting flange in turn gets connected to Transformer Tank which is always earthed. Thus Test tap is also, ensured as earthed.

The main current carrying conductor is a solid Aluminium/Copper rod (Refer GAD).

Air end and Oil end terminals are flat palms and suitable for direct connection of flat flexible jumpers.

For connection of flexible jumpers, Air end terminals have free holes and Oil end terminals have either tapped holes (with SS heli-coil inserts) or free holes.

All metal parts are non-magnetic, and corrosion protected. Terminals are Electro-plated and protected from oxidation by contact grease coating.

The bushing is housed in Air end & Oil end insulators, Mounting flange.

The annular space inside the bushing housing is filled with transformer oil and appropriate space above oil level is evacuated and flushed with Nitrogen ( $N_2$ ) gas, which works as cushion to compensate volumetric changes in oil due to temperature variation on account of site ambient and current flow during bushing operation.

Bushings are supplied with Hermetic seal, preventing the oil inside to come in contact with ambient air (atmosphere), so as to ensure healthy insulation throughout service life of bushing. Hermetic sealing ensures the bushing as maintenance free equipment.

The entire bushing assembly is held together by pre-stressed spring assembly. Spring assembly compensates the effect of change in length of central stem due to temperature variation and maintains required sealing pressure on entire housing-assembly.



Routine Testing at YASH test Lab.:

- Routine Electrical tests on all bushings are conducted in accordance to IEC 60137, simulating the service conditions.
- After complete bushing assembly, the bushing is subjected to oil tightness test to ensure no oil leakages.
- For OIP insulated Bushings, the Capacitance, Tangent  $\delta$  and Partial discharge quantity, are measured in ascending & descending voltage steps up to the rated system voltage.
- Dry power-frequency voltage is maintained for one-minute duration and bushing withstandability is verified by repetition of Di-electric tests after Dry Power- frequency voltage withstand test.

**4. GENERAL OPERATING CONDITIONS:**

- 2.1 Application : Transformers
- 2.2 Insulation : OIP Condenser or Oil Insulated
- 2.3 Application : Oil to Air.
- 2.4 Ambient temperature : -20 to + 40 °C
- 2.5 Oil Temperature :  $\leq 60$  °C above ambient.
- 2.6 Altitude of site :  $\leq 1000$  m.
- 2.7 Mounting angle :  $\leq 30^\circ$  maximum to Vertical.
- 2.8 Oil level below Mounting Flange : Always above BCT length  
*Special operating conditions are guaranteed in GAD.*

**5. UNPACKING**

	<p><b>Attention</b> Bushings must be handled with extensive care. Bumps, Impacts and shocks must be avoided. Any damage to the bushings must be reported immediately to YASH.</p>
	<p>Open the packing case carefully so as to preserve for re-use. The original packing case/materials of bushing shall be retained and stored in dry condition for repacking purpose.</p>



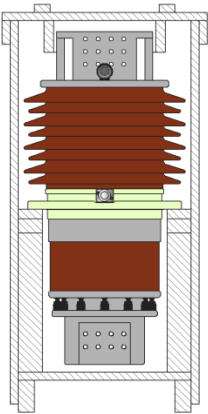
**Attention** Bushing terminal holes **must not** be used for lifting the bushing.

Terminals' surface must be protected from damage.

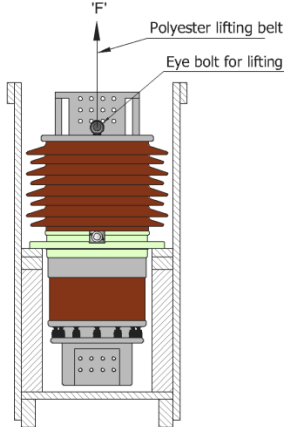


After unpacking, the bushing is always to be placed on **SOFT BEDDING** to avoid damage to oil end terminals.

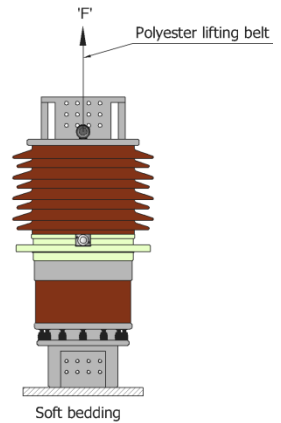
### VERTICAL PACKING BOX



Position- A1 Bushing in packing box



Position- A2 Lifting from the packing box



Position- A3 Resting the Bushing



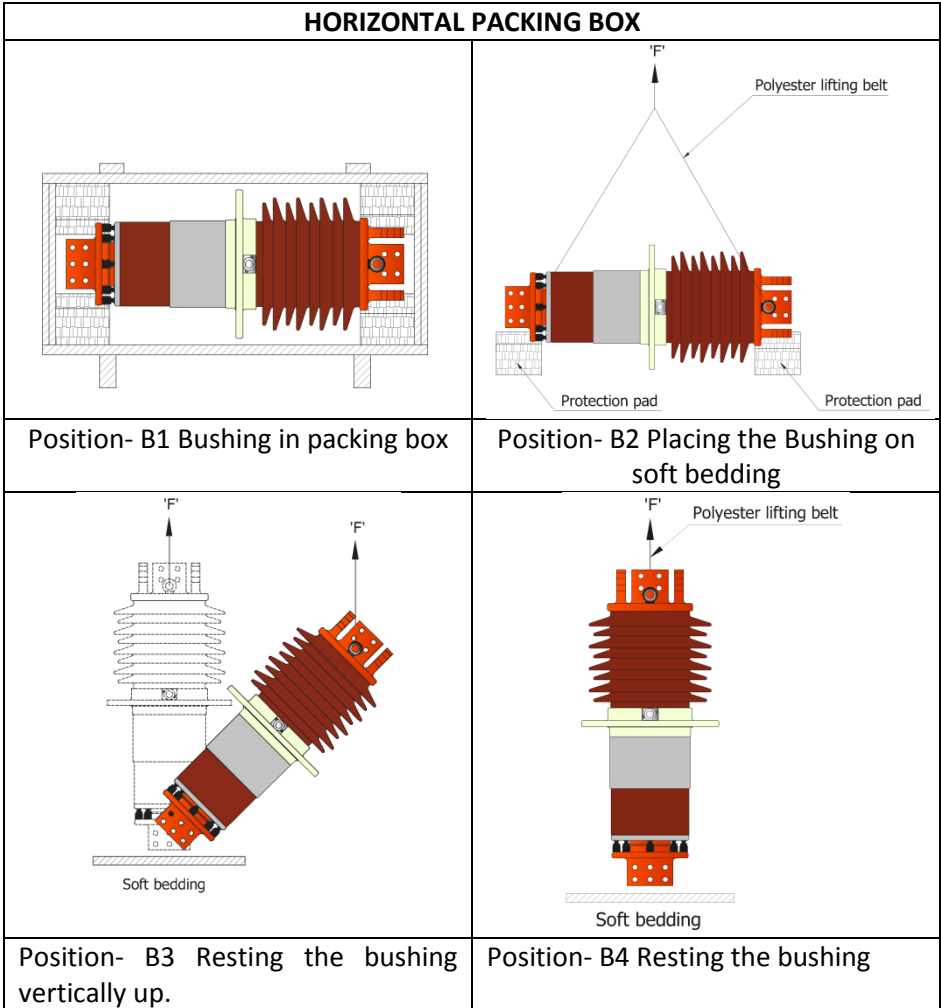


Figure 2: Lifting the bushing



## 6. CHECKS BEFORE ERECTION:

### 6.1 Visual Examination checks:

Bushing to be examined thoroughly for any damages incurred during transport viz. crack/chip-off of Insulator, visible oil leakage from any of bushing part etc. If any of such damages noticed, bushing should not be used for commissioning purpose and should be reported to YASH HIGHVOLTAGE immediately.


### 6.2 Capacitance & Tangent Delta Measurement:

Capacitance  $C_1, C_2$  and Tangent delta measurement of the received bushing to be carried out and compared with factory test results.

	<p><b>Attention</b> If the measured value of capacitance is found to be higher or lower by 10% of value mentioned in Routine Test report, YASH HIGHVOLTAGE is to be consulted immediately and bushing must not be used till verified and cleared by YASH.</p>
	<p><b>Caution</b></p> <p>If the measured value of <math>C_1 \tan \delta</math> varies more than <math>0.001(\text{absolute value})/0.1\%</math>, from the value reported in routine test report or found to be greater than <math>0.007(\text{absolute value})/0.7\%</math>, YASH HIGHVOLTAGE is to be consulted immediately and bushing must not be used till verified and cleared by YASH.</p> <p><b>Bushing must not be energized before the given value limits of Capacitance &amp; <math>\tan \delta</math> are achieved in site testing.</b></p>

## 7. ERECTION & CONNECTIONS:


Lift the bushing vertically up & slowly lower it into transformer turret. Care must be taken so as to avoid impact of transformer tank on bushing while lowering.

	<p><b>Caution</b> Minimum Clearances of Earth parts from Bushing’s live part must be ensured as per GAD. Faliure to do so can result in flashover/arcng on energizing and leading to Bushing failure.</p>
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Mounting bolts to be appropriately tightened to seal the transformer as per the transformer manufacturer’s Instruction manual.

Recommended torque values are tabulated below in order to provide adequate gasket compression for mounting flange sealing.

Bolt size	M12	M16
Torque for mounting bolts in (N-m)	60	120

	<p><b>Attention</b> After mounting the bushings on transformer turret, mounting flange <b>must be</b> connected to earth potential.</p>
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Flange Earthing should be done using Copper braided wire of  $\geq 50 \text{ mm}^2$  Copper wire in the two M12 tapped holes for earth connection.

	<p><b>Caution</b> The contact surfaces of the bushing are electroplated; hence do not use emery or any abrasive articles to clean. Wipe clean with a lint free cloth using suitable cleaning agent.</p>
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Connections to transformer lead and bus duct shall be done carefully so that the contact surfaces are properly seated on the flat terminals of the bushing.

It is a good practice to allow flexibility for the jumpers to allow for dimensional variations of tanking as well as to take care of the thermal expansion/ contraction of the conductors.

If bare aluminium/copper bus is to be connected, remove the oxide layers positively by abrasive cloth polishing in two directions, just before connection. Apply contact grease to expel moisture from joint area.

**Attention**

In order to maintain adequate contact pressure, the terminals should be properly tightened. Failure to perform a proper connection may result in overheating.

**Use of torque wrench is recommended.**

**Caution**

Flat to flat seating is very important, in case of doubt, check with a slip gauge of thickness <5 micron.

The average contact pressure shall be at least One kg/Ampere. For the M12 screws to be used, the recommended tightening torque is 6 kg-m (59 N-m). All screws shall be lubricated before tightening.

In order to maintain a contact pressure, every screw at the terminals should have proper spring washers. At the air side, use spring washers on both Outer sides of the jumper. Every spring washer shall be placed on a flat washer with larger diameter.

## 8. CHECKS BEFORE COMMISSIONING/ENERGIZING:

8.1 Before commissioning/energizing the bushing, it must be kept in vertical position for minimum 12 hours, if the storage period is 1 month or lower; however, in case of longer than 1-month storage period, bushing must be re-kept in vertical position for a minimum 1-week prior energizing.



**Attention:** Before commissioning, a waiting time of **24 hours** for repeated air release from transformer turret is required to avoid air bubbles on the insulating body which can cause flashovers or partial discharges.

8.2 Oil Tightness check between bushing flange & transformer tank.

8.3 Before commissioning, inspect bushing once again for any abnormality as explained in 'Visual checks' (6.1).

8.4 Before commissioning, once again check Capacitance and Tan Delta for any abnormality as explained in 'Capacitance & Tan Delta Measurement' (6.2).



Test tap should be in closed condition during operation. Keeping the test tap cap/cover open can result into fatal high voltage appearing on test tap.

## 9. ROUTINE CHECKS AND MAINTENANCE

Bushing is self-contained & hermetically sealed, hence it is practically maintenance free. However periodic cleaning & checking as explained below should be practiced.



**Attention: No work at all can be performed on bushing, while it is energized or not earthed."**

9.1 Periodic cleaning of air end insulator must be done in order to remove deposited dust particles & moisture drops on it.

9.2 Capacitance & Tangent Delta measurement and records as per procedure explained in cl. 6.2, must be carried out at regular intervals (Recommended at least every six months).

For the reference, initial reading recorded before commissioning should be considered as base. The next values of test results are to be compared with these results.



Any variation in  $C_1$  Capacitance values more than 10% of base value should be reported immediately to YASH HIGHVOLTAGE.

Any variation in  $C_1$  Tangent Delta more than 0.001 (absolute value)/ 0.1% of previously recorded value (6 monthly) should be reported immediately to YASH HIGHVOLTAGE.

*(Not Applicable to Oil Insulated/Non-condenser Bushings)*

### 9.3 Check for oil leakage from joints



**Caution** Oil leaking may not cause immediate problem but is potential for moisture ingress and major electrical break down.

### 9.4 Thermography of Bushing to check any overheating on Bushing, while in operation at maximum rated current.



**Caution:** *At maximum rated current, the bushing outer terminal normally takes a temperature of about 35 to 45 °C above the ambient air. Significantly higher temperatures, especially at lower current loading, can be a sign of bad connections.*

## 10. DISMANTLING, REPACKING AND STORAGE.

Bushing can be dismantled and kept vertical, in a clean and dry environment. No special precautionary measures are needed after removal, because the bushing is completely sealed.

### Repacking

The bushings should be repacked and stored/transported in original packing box, maintaining the original packing scheme as delivered from manufacturer's premises.

### Storage

For long term storage, it is recommended that the bushing should be stored in vertical condition, protected from any damage, with the firm mounting.



**Caution** Storage place should be clean, dry & adequately ventilated indoor place, such that bushing remains dry. Stacking of bushing should be such that there is no damage to packing case & hence to bushing

**NOTE: On completion of service period of Bushing, it can be disassembled, and components can be recycled or disposed as per the local regulations of the region.**

*Part details are given in Product description.*

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